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Generalized Regression Neural Network Based Wind Speed Prediction Model For Western Region Of India

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Abstract

With the growing demand of power generated by wind energy, prediction of wind speed has become an important region for research. In this paper, wind speed is predicted using Generalized Regression Neural Network (GRNN) and Multi-layer perceptron (MLP) in 67 cities of India. The input variables used are: Longitude, Latitude, daily solar radiation- horizontal, air temperature, relative humidity, earth temperature, elevation, cooling degree-days, heating degree-days, atmospheric pressure. The MSE of the two models are compared and found that GRNN gives better result than MLP. The accuracy of GRNN and MLP are 99.99% and 97.974% for training phase and 98.85% and 95.23% for testing phase respectively.

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*Keywords:*wind speed; prediction; GRNN; MLP; ANN;

1. Introduction

Wind energy is the easiest available resource in today's world. It is the most pure and easily accessible energy. Due to this it must be used responsibly to gain maximum benefit out of it. India is on second position in population. With the emerging population, the demand for energy is rising rapidly. Most of the sources for completing this demand are non-renewable and are on the verge of extinction. There are many renewable sources which can be utilized for generating energy. Wind is one of them, which can be used for energy generation more effectively. The

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most commonly method used for electricity generation from wind is by using wind turbines. To install the wind farm at any particular area the wind speed prediction in that area must be accurate.

Wind is uncontrollable and have properties of randomness. Due to which it is difficult to predict the wind speed correctly. Many models are developed for the prediction of wind speed. The most commonly used model is Artificial Neural Network (ANN). In this paper we have developed two models using GRNN and MLP. Then these two models are compared to find out which gives better result.

2. Methodology

In this section the dataset used for this study is described along with the brief introduction of GRNN, MLP and the implementation of the GRNN for predicting the long term wind speed.

2.1 Dataset collection for study

The selected 26 cities of India are used for training the GRNN model, 21 cities of Gujarat are used for testing and 20 cities of Gujarat are used for prediction[1]. The training, testing and prediction cities are shown in the Table 1. The real time data of these cities are collected from the NASA[2]. Using this data long term wind speed prediction is done. The variables which are used as input are: Longitude, Latitude, daily solar radiation- horizontal, air temperature, relative humidity, earth temperature, elevation, cooling degree-days, heating degree-days, atmospheric pressure. Monthly average values for a year of these variables are recorded.

Table 1. Data sets used for study

Datasets of 26 Locations of India are used for training											
S.N.	**city**	**Lat. (Deg.)**	**Lon. (Deg.)**	**S.N.**	**city**	**Lat. (Deg.)**	**Lon. (Deg.)**	**S.N.**	**city**	**Lat. (Deg.)**	**Lon. (Deg.)**
1	Srinagar	34.08	74.79	10	Bhavnagar	21.77	72.15	19	Minicoy	8.28	73.03
2	New Delhi	28.35	77.12	11	Nagpur	21.09	79.07	20	Thiruvanthpuram	8.5	76.9
3	Jodhpur	26.18	73.01	12	Mumbai	19.07	72.51	21	Dehradun	30.19	78.02
4	Jaipur	26.92	75.82	13	Pune	18.52	73.84	22	Lucknow	26.45	80.56
5	Varanasi	25.45	82.85	14	Hyderabad	17.36	78.48	23	Hamirpur	31.68	76.52
6	Patna	25.61	85.13	15	Vishakhapatnam	17.43	83.14	24	Ahmedabad	23.04	72.38
7	Shillong	25.34	91.53	16	Panjim	15.49	73.81	25	Bangalore	12.57	77.38
8	Bhopal	23.25	77.42	17	Chennai	13.081	80.27	26	Kolkata	22.39	88.27
9	Ranchi	23.35	85.33	18	Port Blair	11.61	92.72				
Datasets of 21 cities are used for testing purposes											
1.	Ahmadabad	23.05	72.66	8.	Bhuj	23.25	69.81	15	Godhra	22.75	73.66
2.	Amreli	21.6	71.25	9.	Bulsar	20.6	72.98	16	Idar	23.83	73.03
3.	Anand	22.53	73.0	10.	Dabhoi	22.18	73.41	17	Jakhau	23.23	68.75
4.	Anklesvar	21.63	73.03	11.	Dhandhuka	22.35	72.03	18	Jamnagar	22.45	70.11
5.	Bansda	20.75	73.46	12.	Dholka	22.73	72.48	19	Jasdan	22.06	72.51
6.	Bharuch	21.68	73.01	13.	Dhoraji	21.75	70.61	20	Junagadh	21.51	70.6
7.	Bhavnagar	21.76	72.18	14.	Dhrangadhra	22.98	71.51	21	Kheralu	23.9	72.66
Datasets of 20 cities used for Prediction purpose											
1	Limbdi	22.56	71.88	8	Palanpur	24.2	72.44	15	Rapar	23.53	70.06
2	Mahesana	23.7	72.61	9	Palitana	21.51	71.88	16	Taranga Hill	24.05	72.73
3	Mandvi	22.85	68.53	10	Patan	23.86	72.01	17	Tharad	24.38	71.61
4	Modasa	23.46	73.35	11	Petlad	22.48	72.08	18	Vadodara	22.0	73.26
5	Mundra	22.81	69.86	12	Porbandar	21.61	69.81	19	Viramgam	23.13	72.11
6	Navsari	21.11	73.66	13	Radhanpur	23.08	71.63	20	Visavadar	21.36	70.86
7	Padra	22.25	73.11	14	Rajkot	22.3	70.93				

2.2 Generalized Regression Neural Network (GRNN)

GRNN is generally used for function approximation. It is a learning algorithm with highly parallel structure. The main objective of this algorithm is to obtain the perfect mapping between the input vector and the target vector with minimum error. It has two layers: radial basis layer and a special linear layer[3]. The Radial Basis Layer contains

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